

SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING
JANUARY, 1926

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, 52:42, January, 1925, 53:29, and July, 1925, 53:318.

From Table 1 it is seen that solar radiation intensities averaged slightly above January normals at Washington and Lincoln, and slightly below at Madison.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged close to the January normal at Washington and decidedly below the normal at the other two stations.

Skylight polarization measurements were not made at either Washington or Madison on account of the presence of snow on the ground at both stations during most of the month.

TABLE 1.—Solar radiation intensities during January, 1926

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date		Sun's zenith distance										Local mean solar time		
		8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78 7°		Noon	
		75th mer. time	Air mass											
			A. M.						P. M.					
			e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0		5.0	e.
Jan.	2	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.		
	2	3.30	0.56	0.67	0.91	1.21						3.15		
	6	8.81						1.18	1.06			7.87		
	11	1.60	0.70	0.83	1.23							2.62		
	16	2.62		0.77	0.96							3.45		
	19	5.79	0.70	0.77	0.93	1.20		1.20				4.57		
	28	1.60	0.89	1.10	1.21	1.37		1.32				0.79		
	29	0.64		1.11	1.15	1.29		1.25				1.02		
Means			0.71	0.88	1.06	1.27		1.24	(1.06)					
Departures			-0.03	+0.04	+0.06	+0.04		+0.02	+0.03					

* Extrapolated.

551.510.4 (753)

A STUDY OF THE SMOKE CLOUD OVER WASHINGTON, D. C., ON JANUARY 16, 1926

By IRVING F. HAND

The smoke cloud which covered Washington, D. C., on January 16, 1926, furnished an excellent opportunity to study the effect of city smoke. Eye observation and actual quantitative measurements of atmospheric pollution were made at both the central office of the Weather Bureau, which is located about 2 miles west of the Capitol, and at the American University, about 3 miles northwest of the Weather Bureau. The former point is about 80 feet above sea level, while the latter is 300 feet higher.

The regular 8 a. m. dust count made at the university gave 876 particles per cubic centimeter, or about one-half the average for the month. The sky was cloudless, the winds light and variable, and visibility slightly above average, hills in Maryland 10 miles to the west being visible. With a minimum temperature

TABLE 1.—Solar radiation intensities during January, 1926—Cont.
Madison, Wis.

Date		Sun's zenith distance										Noon		
		8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°			
		75th mer. time	Air mass										Local mean solar time	
			A. M.					P. M.						
			e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0			5.0
Jan. 7		mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.			
9		1.52	1.10	1.22	1.24	1.30					1.68			
13		1.63	0.91	1.03	1.16	1.30					1.96			
15		1.68			1.33						1.24			
18		1.45	1.13	1.21	1.34				1.23		1.88			
22		3.00							1.20		2.87			
23		0.51		1.14	1.26	1.39			1.24	1.09	0.86			
25		0.79	0.85	0.98	1.13						1.45			
28		1.37							0.97		1.68			
29		0.36	1.09	1.23	1.35	1.53			1.31		0.43			
29		0.91		0.70	0.90	1.14					2.36			
Means			1.02	1.07	1.21	1.34			1.19	(1.09)				
Departures			+0.05	-0.01	-0.03	-0.02			-0.03	-0.04				

Lincoln, Nebr.

Jan. 11	1.60	1.16	1.27	1.35	1.54			1.40	1.26	1.15	1.09
13	2.49							1.22	1.11	0.99	3.81
14	3.81	1.06	1.19	1.32				1.34	1.20		4.17
17	3.30								1.02	0.88	4.67
18	3.15								0.99	0.96	4.37
22	0.58			1.16	1.11			1.06	0.89	0.73	1.24
23	1.78	0.93	1.08	1.22	1.37			1.18	0.90	0.83	2.87
24	2.06			1.13							1.68
29	3.15	0.94	1.02	1.18	1.39						4.37
Means	1.02	1.14	1.23	1.35				1.22	1.05	0.92	
Departures	+0.10	+0.11	+0.06	-0.02				+0.02	+0.01	+0.01	

TABLE 2.—Solar and sky radiation received on a horizontal surface
[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation					Average daily departure from normal		
	Washington	Madison	Lincoln	Chicago	New York	Washington	Madison	Lincoln
	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
January 1926								
1	144	102	122	29	71	-9	-40	-67
8	165	166	162	65	80	+6	+14	-37
15	147	147	206	50	77	-21	-20	-4
22	201	192	223	71	108	+22	+6	-5
Deficiency since first of year on January 28						-14	-280	-791

of 23° F., householders not only stoked their fires earlier, but used larger quantities of fuel, both of which, together with the favorable meteorological conditions, added materially to the accumulation of smoke over the city.

By 10 o'clock the smoke had become so dense in the business section that artificial lighting was necessary in both office buildings and on the streets. At this time the smoke could be seen from the university campus rising above the city with a flattish and irregular dome-shaped head. Upon being apprised of the unusual conditions in the city, the writer at once went to central office, but unfortunately passed through the densest part of the cloud on the way.

A measurement made at central office at 11:20 a. m., or about an hour after the passage of the smoke cloud,

gave 6,552 particles per cubic centimeter. While this is less than the maximum obtained on April 7, 1925 (1), no doubt had a measurement been taken an hour earlier it would have yielded a much larger number of particles.

Although the actual number of particles obtained in the downtown section is nearly eight times that obtained at the suburban point, this does not tell the entire story. The count at the American University revealed a considerable portion of mineral matter and most of the soot particles were much smaller than the ones obtained later in the day. This is probably accounted for by the

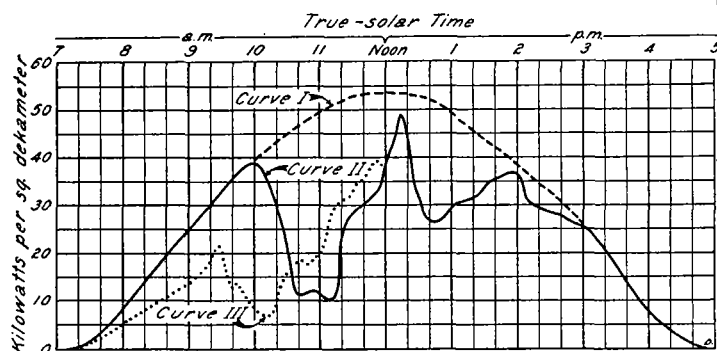


FIG. 1.—Curve I. Total thermal energy per square dekameter of horizontal surface to be expected at the American University with a cloudless sky, January 16, 1926

Curve II. Actual thermal energy per square dekameter of horizontal surface received at the American University, January 16, 1926

Curve III. Actual thermal energy per square dekameter of horizontal surface received at the National Academy of Science Building, Twenty-first and B Streets NW., D. C., during the morning of January 16, 1926

fact that the smoke particles obtained at the university were the laggards, or particles from smoke of previous days so tiny that they had not yet fallen to the ground.

A most objectionable feature of particles in fresh smoke is the fact that they are composed of from 20 to 40 per cent tarry products, when the smoke comes from plants not equipped with an effective smoke consumer—and practically no residences are so equipped. On the other hand, a well designed smoke consumer reduces the tarry composition to about 1 per cent.

The accompanying Figure 1 shows graphically the decrease in the total thermal energy received from the sun and sky on a horizontal surface at both the American University and at the National Academy of Science Building, Twenty-first and B Streets NW., as compared with a smoke-free sky. Comparison of Curves II and III shows clearly the passage of the cloud from the city to the university campus.

The intensity of thermal energy received on a horizontal surface at the American University at 11 a. m. was 11 kilowatts per square dekameter as compared with the 49 kilowatts that would have been received had the sky been free from smoke. Computed on the basis of a square mile, or 25,900 square dekameters, the energy received with a clear sky becomes 1,269,100 kilowatts, and for a smoky sky 284,900 kilowatts. Therefore the loss of energy per square mile was nearly 1,000,000 kilowatts per square mile, or sufficient energy to support 25 million 40-watt lamps.

Lieutenant Smirnoff of the Potomac Electric Power Co. informs me that at 11 a. m. on January 16 in what is known as the down-town section of Washington, covering about $3\frac{1}{2}$ square miles, the electric load was 64,000 kilowatts, as compared with an average for this hour in January on clear days of 52,000 kilowatts.

Besides the loss in thermal solar energy due to the smokiness of the air over cities, perhaps a more serious loss is the almost complete elimination of ultra-violet radiation, which recent investigations have shown to be of great physiological importance.

The Washington smoke cloud of January 16, while unusual for this city, was no denser than that commonly found when light winds prevail in the business centers of large cities where bituminous coal is burned (2).

LITERATURE CITED

- (1) Hand, Irving F.
1925. Effect of local smoke on visibility and solar radiation intensities. *Mo. Wea. Rev.*, 53: 147-148.
- (2) Kimball, Herbert H., and Hand, Irving F.
1924. Investigations of the dust content of the atmosphere. *Mo. Wea. Rev.*, 52: 133. See especially "Dust counts away from Washington," pp. 138-139.

551.506 (261.1)

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

January is considered the stormiest month of the year over the North Atlantic and during the current month the number of days with winds of gale force not only exceeded the normal, as shown on the Pilot Chart, over the greater part of the ocean, but during the first and last decades the wind attained hurricane force over an unusually large area. The weather during the latter period was especially severe and was responsible for the large number of casualties reported, including the wreck of the *Antinoe*, *Laristan*, and a number of other vessels. Taken as a whole the month will be remembered as one of the most severe on record, and a number of trans-Atlantic vessels reported from 4 to 5 separate storms en route, covering practically the entire voyage.

As is often the case during protracted periods of stormy weather, fog was comparatively rare over the Grand Banks, the steamer lanes, and off the European coast, although unusually prevalent in the Gulf of Mexico, where it was reported on 6 days.

TABLE 1.—Averages, departures, and extremes of atmospheric pressure at sea level, 8 a. m. (seventy-fifth meridian time). North Atlantic Ocean, January, 1926

Stations	Average pressure ¹	Departure	Highest	Date	Lowest	Date
	Inches		Inches		Inches	
St. Johns, Newfoundland.	29.58	−0.37	30.10	17th	28.62	29th
Nantucket.	29.97	−0.12	30.44	8th	29.38	28th
Hatteras.	30.10	−0.02	30.48	29th	29.64	22d
Key West.	30.09	0.00	30.24	1st	29.92	30th
New Orleans.	30.13	+0.01	30.40	1st	29.76	31st
Swan Island.	29.92	−0.06	30.00	23d	29.84	21st
Turks Island.	30.11	+0.13	30.20	4th	29.94	14th
Bermuda.	30.20	+0.07	30.48	17th	29.70	14th
Horta, Azores.	30.08	−0.02	30.52	16th	29.62	9th
Lerwick, Shetland Islands	29.66	−0.05	30.47	13th	29.19	23d
Valencia, Ireland.	29.68	−0.22	30.23	13th	28.83	31st
London.	29.87	−0.13	30.33	12th	29.34	3d

¹ From normals shown on H. O. Pilot Chart, based on observations taken at Greenwich mean noon, or 7 a. m., seventy-fifth meridian.

² And on other dates.

Unusually low average pressure prevailed at the stations on the American coast north of Nantucket, as well as the coast of northern Europe. The average at Horta was near the normal, although winds of force 7 or higher